DOI: https://doi.org/10.53350/pjmhs2023175435

ORIGINAL ARTICLE

Effectiveness of Different Volumes of Articaine for Inferior Alveolar Nerve Block for Mandibular Molar Teeth with Symptomatic Irreversible Pulpitis

MUHAMMAD UMAIR[1], MOHAMMAD TAHIR[2], SYED ABDUL RAUF SHAH[3], MUHAMMAD ATHAR KHAN[4], SYEDA RABIA RAHAT GEELANI[5], HAMZA ULFAT[6]

[1]*Assistant Professor, Oral Medicine, Foundation University School of Health Sciences, Islamabad.*
[2]*(MSc Endo Riphah University), Ex.HOD, Dental Department, DHQ Teaching Hospital DI Khan, KPK*
[3]*Professor, Maxillofacial Surgeon, Dentistry / Oral & Maxillofacial Department, Quetta.*
[4]*BDS, FCPS, 9231-D, Assistant Professor Oral & Maxillofacial Surgery, Bakhtawar Amin Medical & Dental College, Multan.*
[5]*Assistant Professor Oral & Maxillofacial Surgery Department, Foundation University College of Dentistry, Islamabad.*
[6]*Senior Registrar, Operative Dentistry & Endodontics, Dental College HITEC-IMS Taxilla*
Corresponding author: Mohammad Tahir, Email: drmuhammadtahir9@gmail.com

ABSTRACT

Objective: The objective of this study was to determine which of two different volumes of articaine is more efficient for performing an inferior alveolar nerve block (IANB) in the treatment of symptomatic irreversible pulpitis in molars.

Study Design: Randomized Study

Place and Duration: Foundation University School of Health Sciences, Islamabad and Dental Department, DHQ Teaching Hospital DI Khan, KPK from May, 2022 to April, 2023.

Methods: Total 94 patients had mandibular molar teeth with symptomatic irreversible pulpitis were included. After obtaining informed written consent detailed demographics of enrolled cases included age, sex, type of molars and education status were recorded. 47 mandibular molar teeth received 2 cartridges (3.6 mL) of 4% articaine in group I and 47 cases of group II received 1 (1.8 mL) of 4% articaine. We used a Heft-Parker visual analog scale to record their levels of discomfort prior to, during, and after access cavity preparation and root canal instrumentation. If the anaesthetic only dulled the pain, it was a success. The t-test and the chi-square test were used to assess the data.

Results: There were majority 59 (62.8%) males and 35 (37.2%) females in our study. The included patients had mean age 30.21±16.58 years. Majority of the cases had first molars 55 (58.5%) and 39 (41.5%) cases had second molars. Total 43 (45.7%) cases were educated and 51 (54.3%) cases were non educated. Although neither group achieved 100% success with their anesthetic, we found that 3.6 mL articaine resulted in a considerably greater success rate for IANBs (39, 82.97%) than 1.8 mL of the same amount of anesthetic solution (17, 36.2%) (P <0.003). We found a significantly reduction in pain score (HP VAS)1.19±5.37 as compared to group II 3.6±7.17 with p value <0.004.

Conclusion: In our research, we found that increasing the volume of articaine greatly improved the success rate of IANBs in teeth with symptomatic irreversible pulpitis in the mandibular molars, but did not guarantee complete anesthetic success in all cases.

Keywords: Articaine, inferior alveolar, Anesthesia, mandibular molar, nerve block, irreversible pulpitis, symptomatic

INTRODUCTION

Achieving and maintaining thorough anaesthesia are prerequisites for endodontic therapy. The percentage of teeth that need endodontic therapy has grown dramatically, with mandibular teeth being the most common to require treatment.Infiltration is the most frequent injection technique for anaesthetizing maxillary teeth, while Inferior Alveolar Nerve Block (IANB) is the most common injection approach for anaesthetizing mandibular teeth ([1]).[2] It's more challenging to anaesthetize a tooth with a pulp that's been irritated.Local anaesthetic failure is reported to occur in teeth with irreversible pulpitis eight times more frequently than in non-inflamed control teeth, according to a recent study [3].[4] In irreversible pulpitis, an inferior alveolar nerve block can be used to numb the lips, although pulpal anaesthesia may not work.When it comes to numbing the jaw's lower teeth, [5] IANB is the gold standard for injectable anaesthetics. IANB can be supplemented or even replaced with other methods, including as interosseous, periodontal ligament anaesthesia, and buccal infiltration anaesthesia.[2] Even when administered correctly, IANB has the greatest proportion of clinical failures (about 15% to 20%).It is not required in endodontics when the IANB broad region is anaesthetized [2]. Injection of IANB can cause temporary paralysis of the face, trismus, local anaesthesia administered into a blood artery, self-inflicted trauma, sphenomandibular ligament injury, and infection of the pterygomandibular region. Compared to IANB and other options like intraosseous and intraligamental injections, buccal infiltration is a less complicated method. Unlike intraosseous administration, which necessitates specific equipment, infiltration anaesthesia may be administered with commonplace instruments. Less damage is done to the periodontal ligament, and the risk of bacteremia after intraligamental injection is eliminated.

Some authors have suggested that more effective pulpal anaesthesia can be achieved by using 2 anaesthetic cartridges in the IANB (3.6 mL) with 2% lidocaine with different concentrations of epinephrine in asymptomatic teeth [6] and in teeth with irreversible pulpitis [7]. When other writers doubled the anaesthetic amount, they found no statistically significant difference in lidocaine success or failure independent of epinephrine concentration [8]. This was true for both healthy and diseased teeth. One research comparing two different volumes (1.8 mL and 3.6 mL) of the 4% articaine solution with 1:100,000 epinephrine in the standard IANB in mandibular molars with irreversible pulpitis was the only one we could find ([9]). A recent systematic study found that the success rate of IANB in mandibular molars with irreversible pulpitis was dramatically boosted by increasing the amount of the anaesthetic agent from 1.8 to 3.6 mL [10]. However, there are surprisingly few citations for actual research in this summary. This leads us to conclude that further research on the topic is required.

In 1969, articaine was initially synthesised in Germany and given the designation HOE 40-045. It wasn't until 1976 that articaine hydrochloride was approved for use in clinical settings. In 1971, Winther and Nathalang conducted the first clinical trials of articaine and found that 2% articaine with 1:200,000 adrenaline produced profound anaesthesia for all teeth except mandibular molars and was superior to 2% lidocaine with 1:200,000 adrenaline in anaesthetic duration and extent.[11] A 4% formula of articaine with 1:100,000 adrenaline was authorised by the US FDA in 2000 and marketed as Septocaine (Septodont). The original name, carticaine, had been changed to articaine in 1984. Articaine 4% with adrenaline 1:200,000 was authorised by the FDA in 2006.

Maxillary infiltrations with LA articaine take around 1.5–1.8 minutes to take effect, whereas mandibular blocks take about 1.5–3.6 minutes. When compared to lidocaine, mepivacaine, and

prilocaine, the anaesthetic effect of articaine on the pulp lasts for 30–120 minutes. Soft tissue anaesthesia induced by articaine injections into the maxilla lasts around 2.25 hours, whereas mandibular blocks last about 4 hours.[12]

Our research aimed to compare the effectiveness of two different articaine volume administrations for an inferior alveolar nerve block (IANB) in the management of molar teeth with symptomatic irreversible pulpitis.

MATERIALS AND METHODS

This randomized study was conducted at Foundation University School of Health Sciences, Islamabad and Dental Department, DHQ Teaching Hospital DI Khan, KPK from May, 2022 to April, 2023 and comprised of 94 patients. Both the written health history and the subjects' responses to direct questions confirmed that all participants were in good health and not using any drugs that could affect their ability to feel pain. The sample size was determined using the WHO sample size calculator with a 95% confidence level and 80% power of the test. Informed written consent was acquired from all participants.

Patients who met the criteria for symptomatic irreversible pulpitis and who were between the ages of 20 and 65 and were not taking any medications that could affect the impact of local anesthesia and needed endodontic treatment in mandibular molar teeth constituted the study population. Allergies to local anesthetic, pregnancy, incapacity to provide informed permission, and inclusion in the American Society of Anesthesiologists' IV categorization of systemic illnesses led to the exclusion of potential study participants.

Subjects were randomly assigned to one of two groups using a lottery system after a thorough medical history and examination (periapical radiographs and pulp vitality tests) were completed. Patients were given a Visual Analogue Scale (VAS) pain rating before surgery to establish a reference point. A single operator gave all of the anesthetic injections but was not involved in the outcome evaluation. Injections were given using a brand-name 27-G needle linked to a regular aspirating syringe, and 1.8 ml of anaesthetic solution was placed every 60 seconds. Group I was given 2 cartridges (3.6 mL) of articaine 4%. Aspiration was finished once it had reached its intended location. Group II got 4% articaine (1.8 mL) and 1:100,000 epinephrine with a 27 gage 0.4 x 25 mm needle. Adjacent to the mandibular molar, roughly in the middle of the mesial and distal roots, buccal infiltration was delivered. After 10 minutes, we checked in on the anesthetic induction. Lip numbness and the Electric Pulse Tester (EPT) were used to gauge the success of the anesthetic.

We measured discomfort before surgery and during the operation with a Visual Analog Scale (VAS). Before any treatment was administered, every participant was briefed on VAS. A successful or failure anesthetic procedure was recorded. SPSS version 20 was used to compare the two groups' responses to anesthesia using the Pearson chi-square test and Fisher's exact test. Statistical significance was assumed to exist at the 0.05 level.

RESULTS

There were majority 59 (62.8%) males and 35 (37.2%) females in our study. The included patients had mean age 30.21±16.58 years. Majority of the cases had first molars 55 (58.5%) and 39 (41.5%) cases had second molars. Total 43 (45.7%) cases were educated and 51 (54.3%) cases were non educated.(table 1)

Although neither group achieved 100% success with their anesthetic, we found that 3.6 mL articaine resulted in a considerably greater success rate for IANBs 39 (82.97%) than 1.8 mL of the same amount of anesthetic solution 17 (36.2%) (P <0.003).(table 2)

We found a significantly reduction in pain score (HP VAS)1.19±5.37 as compared to group II 3.6±7.17 with p value <0.004.(table 3)

Table-1: Case enrolment characteristics

Variables	Frequency	Percentage
Mean age (years)	30.21±16.58	
Gender		
Male	59	62.8
Female	35	37.2
Mandibular Molars		
First	55	58.5
Second	39	41.5
Education Status		
Educated	43	45.7
Non-educated	51	54.3

Table-2: Comparison of success rate among both groups

Variables	Group I (47)	Group II (47)
Success		
Yes	39 (82.97%)	17 (36.2%)
No	8 (17.03%)	30 (63.8%)

Table-3: Reduction in pain score among both groups

HP VAS	Group I	Group II
At beginning	8.9±5.25	8.7±3.15
After 15 days	3.1±5.11	5.8±2.28
Final Follow-up	1.19±5.37	3.6±7.17

DISCUSSION

All patients receiving either of the two dosages of 4% articaine tested reported substantial lip anaesthesia after 10 minutes of standard IANB. However, at the two dosages used, pulpal anaesthesia was not achieved in all individuals. As a result, although numbness of the lips is commonly employed as a clinical diagnostic of block effectiveness, it is not always an indication of pulpal anaesthesia [13,14]. Previous research [15] shown that 80 A of electric pulp stimulator power was necessary to induce pulpal anaesthesia. Symptom-free teeth and teeth with irreversible pulpitis have been shown to perform differently in these investigations. In asymptomatic teeth, a negative reaction to maximum pulp tester stimulation ensures pulpal anaesthesia, while a positive response indicates discomfort during surgical treatments. A negative reaction did not ensure clinical analgesia in symptomatic teeth undergoing pulpectomy [16].

In current study 94 patients were included in this study. There were majority 59 (62.8%) males and 35 (37.2%) females in our study. The included patients had mean age 30.21±16.58 years. Results were comparable to the previous studies.[17,18] Even with a score of 80 or higher on an electronic pulp tester, which has been the standard measuring instrument for identifying pulpal status in quantitative clinical trials of dental anaesthetic, it is not assured that pulpal anaesthesia will be achieved in teeth that have irreversible pulpitis. This is the case even if the pulpitis has been present for a significant amount of time.[19] It's possible that anaesthetizing symptomatic teeth will be more challenging than anaesthetizing asymptomatic teeth.[20]

The lack of pain was utilised as a criterion for the efficacy of the anaesthetic since we wanted the patient to be as comfortable as possible throughout the procedure. HP VAS was also used to examine the speed with which symptoms diminished following anaesthetic procedures. Previous clinical research (Aggarwalet al., 2009, 2012)[21] show that this advantage is real, with patients reporting much less pain following the first round of anaesthesia. In addition, the false-negative cases in G2 reported a milder to moderate level of discomfort (64 mm) than the positive cases. These data, along with clinical information, reveal that patients who are supplemented with BI experience higher levels of anaesthetic comfort throughout therapy and tend to endure more predictable treatment, suggesting that this method may be an option in SIP situations. of the 94 participants, 47 had buccal infiltrations with 4% articaine (3.6mL). Pain ratings from patients during access cavity creation and pulp removal were used as the primary measure of anaesthetic success. The visual analogue scale (VAS) was used to evaluate pain, and its reliability and validity as a measure of

anaesthetic effectiveness were confirmed. The success rate for achieving pulpal anaesthesia following buccal infiltration with 4% articaine (3.6 mL) was 82.97%, but the success rate after using 1.8 mL was just 36.2%. This is quite close to the 72.7% success rate reported by Currie et al.[22] for articaine buccal infiltration. Even though they used buccal infiltration after failing of IANB with articaine as in mandibular 1st and 2nd molars, the success rate of articaine buccal infiltration in this study is comparable to the work of Ashraf et al.[23].

We found a significantly reduction in pain score (HP VAS)1.19±5.37 as compared to group II 3.6±7.17 with p value <0.004. There are a variety of methods that have been used to evaluate pulpal anaesthesia. Bjorn conducted his research using EPT.[24] Subjects who did not respond to the maximum EPT stimulation received painless dental care. The pulpal anaesthesia of both healthy and inflammatory teeth is evaluated using EPT prior to endodontic treatment. However, permanent pulpitis teeth may not respond to EPT alone, therefore pulpal anaesthesia may not be assured in such cases. Therefore, the most effective option is pain assessment during pulp extirpation and access cavity preparation.[25]

CONCLUSION

In our research, we found that increasing the volume of articaine greatly improved the success rate of IANBs in teeth with symptomatic irreversible pulpitis in the mandibular molars, but did not guarantee complete anesthetic success in all cases.

REFERENCES

1 Ahmed H, Durr-e-Sadaf, Rahman M. Frequency and distribution of endodontically treated teeth. J Coll Physicians Surg Pak 2009; 19:605-8.
2 Shaw I, Chandar K, Dodds C. Oxford textbook of anaesthesia for oral and maxillofacial surgery. Oxford Press 2010; 91-6.
3 Torabinejad M, Walton R. Endodontics: Principles and practice. 4e:2009;142.
4 Fragouli E, Dechouniotis G, Georgopoulou M. Anaesthesia in endodontics. ENDO 2009; 2:171-84.
5 Jung IY, Kim JH, Kim ES, Lee CY, Lee SJ. An evaluation of buccal infiltrations and inferior alveolar nerve blocks in pulpal anaesthesia for mandibular first molars. J Endod 2008; 34:11-3
6 Yared GM, Dagher FB. Evaluation of lidocaine in human inferior alveolar nerve block. J Endod.1997; 23, 575–8
7 Aggarwal V, Singla M, Miglani S, Kohli S, Singh S. Comparative Evaluation of 1.8 mL and 3.6 mL of 2% Lidocaine with 1:200,000 Epinephrine for Inferior Alveolar Nerve Block in Patients with Irreversible Pulpitis: A Prospective, Randomized Single-blind Study. J Endod. 2012; 38,753–6
8 Vreeland DL, Reader A, Beck M, Meyers W, Weaver J. An evaluation of volumes and concentrations of lidocaine in human inferior alveolar nerve block. J Endod. 1989; 15:6–12.
9 Abazarpoor R, Parirokh M, Nakhaee N, Abbott PV. A Comparison of Different Volumes of Articaine for Inferior Alveolar Nerve Block for Molar Teeth with Symptomatic Irreversible Pulpitis. J Endod. 2015; 41:1408–11.
10 Milani AS, Froughreyhani M, Rahimi S, Zand V, Jafarabadiet MA. Volume of Anesthetic agents and IANB: A Systematic Review. Anesth Prog. 2018; 65, 16–23.
11 Cowan, A. A clinical assessment of a new local anesthetic agent—carticaine. Oral. Surg. Oral. Med. Oral. Pathol. 43, 174–180 (1977).
12 Malamed, S. F., Gagnon, S. & Leblanc, D. Articaine hydrochloride: a study of the safety of a new amide local anesthetic. J. Am. Dent. Assoc. 132, 177–185 (2001).
13 Allegretti CE, Sampaio RM, Horliana AC, Armonia PL, Rocha RG,Tortamano IP. Anesthetic Efficacy in Irreversible Pulpitis: A Randomized Clinical Trial. Braz Dent J. 2016; 27, 381–6 https://doi.org/10.1590/ 0103-6440201600663 PMID: 27652697
14 Wali M, Drum M, Reader A, Nusstein J. Prospective, randomized single-blind study of the anesthetic efficacy of 1.8 and 3.6 milliliters of 2% lidocaine with 1:50,000 epinephrine for inferior alveolar nerve block. J Endod. 2010; 36:1459–62
15 Certosimo AJ, Archer RD. A clinical evaluation of the electric pulp tester as an indicator of local anesthesia. Oper Dent. 1996; 21:25–30 PMID: 8957912
16 Dreven LJ, Reader A, Beck FM, Meyers WJ, Weaver J. An evaluation of an electric pulp tester as a measure of analgesia in human vital teeth. J Endod. 1987; 13: 233–8. PMID: 3473179
17 Argueta-Figueroa L, Arzate-Sosa G, Mendieta-Zeron H. Anesthetic efficacy of articaine for inferior alveolar nerve blocks in patients with symptomatic versus asymptomatic irreversible pulpitis. Gen Dent. 2012 Jan-Feb;60(1):e39-43.
18 Martin, E., Nimmo, A., Lee, A. et al. Articaine in dentistry: an overview of the evidence and meta-analysis of the latest randomised controlled trials on articaine safety and efficacy compared to lidocaine for routine dental treatment. BDJ Open 7, 27 (2021).
19 Dreven, L. J. et al. Evaluation of an electric pulp tester as a measure of analgesia in human vital teeth. J. Endod. 13, 233–238 (1987).
20 Heft, M. W. & Parker, S. R. An experimental basis for revising the graphic rating scale for pain. Pain 19, 153–161 (1984).
21 Aggarwal, V., Singla, M., Miglani, S., Kohli, S., & Singh, S. (2012). Comparative evaluation of 1.8 mL and 3.6 mL of 2% lidocaine with 1:200,000 epinephrine for inferior alveolar nerve block in patients with irreversible pulpitis: a prospective, randomized single-blind study. Journal of Endodontics, 38(6), 753-6.10.1016/j.joen.2012.02.003
22 Currie C, Meechan J, Whitworth J, Corbett I. Is mandibular molar buccal infiltration a mental and incisive nerve block. J Endod 2013; 39:439-43
23 Ashraf H, Kazem M, Dianat O, Noghrehkar F. Efficacy of articaine versus lidocaine in block and infiltration anaesthesia administered in teeth with irreversible pulpitis: a prospective, randomized, double-blind study. J Endod 2013; 39:6-10
24 Silva SA, Horliana ACRT, Pannuti CM, Braz-Silva PH, Bispo CGC, Buscariolo IA, et al. (2019) Comparative evaluation of anesthetic efficacy of 1.8 mL and 3.6 mL of articaine in irreversible pulpitis of the mandibular molar: A randomized clinical trial. PLoS ONE 14(7): e0219536
25 Yadav M, Grewal MS, Arya A, et al. Anesthetic Success using Different Volumes of Articaine for Inferior Alveolar Nerve Block in Symptomatic Irreversible Pulpitis: A Randomized, Double-blind Study. World J Dent 2020;11(1):12–16